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(54) Title: WEATHERABLE BLOCK COPOLYESTERCARBONATES AND BLENDS CONTAINING THEM

(57) Abstract

Block copolyestercarbonates may be prepared by first conducting a reaction between resorcinol or an alkyl- or haloresorcinol and at least one aromatic dicarboxylic acid chloride, preferably isophthaloyl chloride, terephthaloyl chloride or a mixture thereof, to produce a hydroxy-terminated polyester intermediate and then conducting a reaction of the intermediate with a dihydroxyaromatic compound, preferably bisphenol A, and a carbonyl halide, preferably phosgene. The products have excellent physical properties, including a high degree of weatherability. They may be blended with other polymers such as polycarbonates and poly(alkylene carboxylates) to improve the weatherability thereof.

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WEATHERABLE BLOCK  
COPOLYESTERCARBONATES AND  
BLENDS CONTAINING THEM

BACKGROUND OF THE INVENTION

5                   This invention relates to resinous compositions of matter, and more specifically to block copolyestercarbonates having improved weatherability.

                  Polycarbonates and polyesters, especially poly(alkylene dicarboxylates), and blends thereof are widely employed classes of  
10                   polymers, in part because of their excellent physical properties including high impact strength. However, their long term color instability is a problem. It causes yellowing, detracting from the transparency and attractiveness of the polymers. Loss of gloss can also be an undesirable long term phenomenon.

15                   Yellowing of polycarbonates and polyesters is caused largely by the action of ultraviolet radiation, which is why such yellowing is frequently designated "photoyellowing". Numerous means for suppressing photoyellowing have been employed and proposed. Many of these involve incorporation in the polycarbonate of ultraviolet  
20                   absorbing compounds (UVA's). For the most part, UVA's are low molecular weight compounds and they must be employed at relatively low levels, typically up to 1% by weight, to avoid degradation of the physical properties of the polymer such as impact strength and high temperature properties as reflected in heat distortion temperature.

25                   Other polymers have been blended with polycarbonates and/or polyesters to improve their resistance to degradation by ultraviolet radiation and loss of gloss, hereinafter sometimes collectively designated "weatherability". Examples of blends of this type are weatherable blends of polycarbonates with copolyesters  
30                   comprising resorcinol iso/terephthalate units, optionally in combination with "soft block" ester units derived from an aliphatic or alicyclic dihydroxy compound or dicarboxylic acid. However, such blends are

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immiscible and their use is, therefore, limited to situations in which transparency is not required. In addition, it is of interest to produce a wider variety of weatherable and weatherability-improving polymers.

Japanese Kokai 56/133,332 describes

- 5 copolyestercarbonates "having a highly alternating orientation". They are prepared by a 2-step process in which the first step is preparation of a hydroxy-terminated polyester oligomer having a degree of polymerization of 1-2 and the second step is treatment of said oligomer with a carbonyl halide such as phosgene to afford a final  
10 product having essentially alternating polyester and polycarbonate linkages; i.e., the degree of polymerization of the carbonate blocks is also about 1-2. These copolyestercarbonates are alleged to have excellent heat resistance, solvent resistance and moldability. No details of their weatherability are provided.

15 SUMMARY OF THE INVENTION

- The present invention is based on the discovery of a class of block copolyestercarbonates having excellent weatherability. Blends of said copolyestercarbonates with other polymers, specifically polycarbonates and polyesters, are resistant to loss of gloss and have  
20 excellent physical properties.

- One aspect of the invention, therefore, is block copolyestercarbonates comprising organic carbonate blocks alternating with arylate blocks, said arylate blocks comprising arylate structural units derived from a 1,3-dihydroxybenzene and at least one  
25 aromatic dicarboxylic acid and having a degree of polymerization of at least about 4.

Another aspect is block copolymers obtained by Fries rearrangement of a block copolyestercarbonate as described above.

- Another aspect is compositions comprising resinous  
30 blends of block copolyestercarbonates as described above with at least one other polymer selected from the group consisting of

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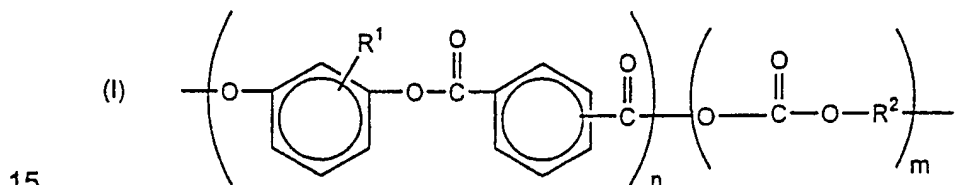
polycarbonates, poly(alkylene dicarboxylates) and addition polymers, and any reaction products of said blends.

Still another aspect is a method for preparing block copolyestercarbonates which comprises:

- 5 (A) preparing a hydroxy-terminated polyester intermediate having a degree of polymerization of at least 4 by the reaction of a 1,3-dihydroxybenzene with at least one aromatic dicarboxylic acid chloride under alkaline conditions, and
- (B) conducting a reaction of said polyester intermediate
- 10 with at least one organic dihydroxy compound and a carbonyl halide.

#### DETAILED DESCRIPTION; PREFERRED EMBODIMENTS

The block copolyestercarbonates of the present invention comprise alternating carbonate and arylate blocks. They include polymers comprising moieties of the formula



- wherein R<sup>1</sup> is hydrogen, halogen or C<sub>1-4</sub> alkyl, each R<sup>2</sup> is independently a divalent organic radical, m is at least about 10 and n is at least about 4. The arylate blocks thus contain a 1,3-dihydroxybenzene moiety which may be substituted with halogen, usually chlorine or bromine, or
- 20 with C<sub>1-4</sub> alkyl; i.e., methyl, ethyl, propyl or butyl. Said alkyl groups are preferably primary or secondary groups, with methyl being more preferred, and are most often located in the ortho position to both oxygen atoms although other locations are also contemplated. The most preferred moieties are resorcinol moieties, in which R<sup>1</sup> is
- 25 hydrogen.

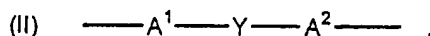
Said 1,3-dihydroxybenzene moieties are bound to aromatic dicarboxylic acid moieties which may be monocyclic moieties, e.g., isophthalate or terephthalate, or polycyclic moieties, e.g.,

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naphthalenedicarboxylate. Preferably, the aromatic dicarboxylic acid moieties are isophthalate and/or terephthalate. Either or both of said moieties may be present. For the most part, both are present in a molar ratio of isophthalate to terephthalate in the range of about  
 5 0.25-4.0:1, preferably about 0.8-2.5:1.

In the carbonate blocks, each  $R^2$  is independently an organic radical. For the most part, at least about 60 percent of the total number of  $R^2$  groups in the polymer are aromatic organic radicals and the balance thereof are aliphatic, alicyclic, or aromatic radicals.  
 10 Suitable  $R^2$  radicals include m-phenylene, p-phenylene, 4,4'-biphenylene, 4,4'-bi(3,5-dimethyl)-phenylene, 2,2-bis(4-phenylene)propane and similar radicals such as those which correspond to the dihydroxy-substituted aromatic hydrocarbons disclosed by name or formula (generic or specific) in U.S. Patent  
 15 4,217,438, which is incorporated herein by reference.

More preferably, each  $R^2$  is an aromatic organic radical and still more preferably a radical of the formula



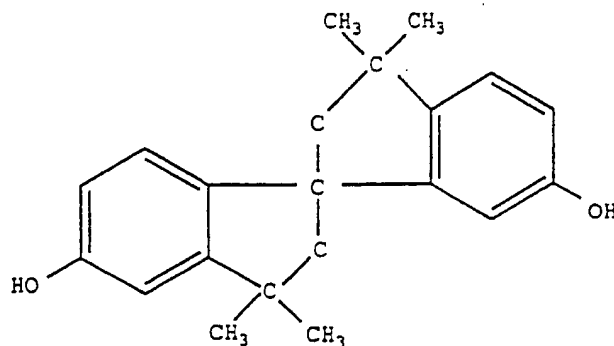
wherein each  $A^1$  and  $A^2$  is a monocyclic divalent aryl radical and Y is a  
 20 bridging radical in which one or two carbon atoms separate  $A^1$  and  $A^2$ . The free valence bonds in formula II are usually in the meta or para positions of  $A^1$  and  $A^2$  in relation to Y. Compounds in which  $R^2$  has formula II are bisphenols, and for the sake of brevity the term  
 "bisphenol" is sometimes used herein to designate the dihydroxy-  
 25 substituted aromatic hydrocarbons; it should be understood, however, that non-bisphenol compounds of this type may also be employed as appropriate.

In formula II,  $A^1$  and  $A^2$  typically represent unsubstituted phenylene or substituted derivatives thereof, illustrative substituents  
 30 (one or more) being alkyl, alkenyl, and halogen (particularly bromine). Unsubstituted phenylene radicals are preferred. Both  $A^1$  and  $A^2$  are preferably p-phenylene, although both may be o- or m-phenylene or one o- or m-phenylene and the other p-phenylene.

The bridging radical, Y, is one in which one or two atoms,  
 35 separate  $A^1$  from  $A^2$ . The preferred embodiment is one in which one

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atom separates A<sup>1</sup> from A<sup>2</sup>. Illustrative radicals of this type are -O-, -S-,  
 -SO- or -SO<sub>2</sub>-, methylene, cyclohexyl-methylene,  
 2-[2.2.1]-bicycloheptyl methylene, ethylene, isopropylidene,  
 neopentylidene, cyclohexylidene, cyclopentadecylidene,  
 5 cyclododecylidene, adamantylidene, and the 2,2,2',2'-tetrahydro-  
 3,3,3',3'-tetramethyl-1,1'spirobi[1H-indene]6,6'-diols having the  
 following formula ;



10

Gem-alkylene (alkylidene) radicals are preferred. Also included,  
 however, are unsaturated radicals. For reasons of availability and  
 particular suitability for the purposes of this invention, the preferred  
 bisphenol is 2,2-bis(4-hydroxyphenyl)propane ("BPA"), in which Y is  
 15 isopropylidene and A<sup>1</sup> and A<sup>2</sup> are each p-phenylene.

The arylate blocks have a degree of polymerization (DP),  
 represented by n, of at least about 4, preferably at least about 10,  
 more preferably at least about 20 and most preferably about 30-150.  
 The DP of the carbonate blocks, represented by m, is generally at  
 20 least about 10, preferably at least about 20 and most preferably about  
 50-200.

The distribution of the blocks may be such as to provide  
 a copolymer having any desired weight proportion of arylate blocks in  
 relation to carbonate blocks. In general, copolymers containing about  
 25 10-90% by weight arylate blocks are preferred.

In step A of the method of this invention for the  
 preparation of block copolyestercarbonates, a 1,3-dihydroxybenzene

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which may be resorcinol (preferably) or an alkyl- or haloresorcinol may be contacted under aqueous alkaline reactive conditions with at least one aromatic dicarboxylic acid chloride, preferably isophthaloyl chloride, terephthaloyl chloride or a mixture thereof. The alkaline  
5 conditions are typically provided by introduction of an alkali metal hydroxide, usually sodium hydroxide. A catalyst, most often a tetraalkylammonium, tetraalkylphosphonium or hexaalkylguanidinium halide, is usually also present, as is an organic solvent, generally a water-immiscible solvent and preferably a chlorinated aliphatic  
10 compound such as methylene chloride. Thus, the reaction is generally conducted in a 2-phase system.

In order to afford a hydroxy-terminated polyester intermediate, the molar ratio of resorcinol to acyl chlorides is preferably greater than 1:1; e.g., in the range of about 1.01-1.90:1. Base may be  
15 present in a molar ratio to acyl halides of about 2-2.5:1. Catalyst is usually employed in the amount of about 0.1-10 mole percent based on combined acyl halides. Reaction temperatures are most often in the range of about 25-50°C.

Following the completion of polyester intermediate  
20 preparation, it is sometimes advantageous to acidify the aqueous phase of the two-phase system with a weak acid prior to phase separation. The organic phase, which contains the polyester intermediate, is then subjected to step B which is the block copolyestercarbonate-forming reaction. It is also contemplated,  
25 however, to proceed to step B without acidification or separation, and this is often possible without loss of yield or purity.

It is also within the scope of the invention to prepare the polyester intermediate entirely in an organic liquid, with the use of a base soluble in said liquid. Suitable bases for such use include tertiary  
30 amines such as triethylamine.

The dihydroxyaromatic compound employed in the second step typically has the formula  $\text{HO-R}^2\text{-OH}$ , wherein  $\text{R}^2$  is as previously defined. Bisphenol A is generally preferred. The carbonyl



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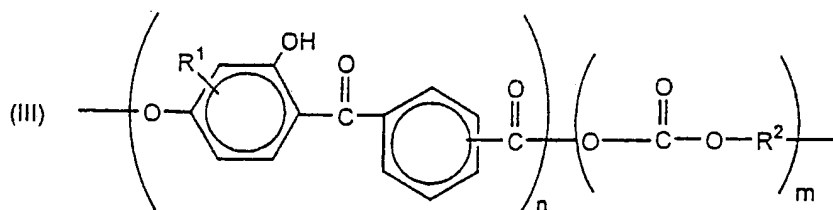
halide is preferably phosgene. This reaction may be conducted according to art-recognized interfacial procedures (i.e., also in a 2-phase system), employing a suitable interfacial polymerization catalyst and an alkaline reagent, again preferably sodium hydroxide, and optionally a branching agent such as 1,1,1-tris(4-hydroxyphenyl)ethane and/or a chain termination agent such as phenol or p-cumylphenol. To suppress scrambling of the block copolymer, the pH is maintained at a relatively low level, typically in the range of about 5-9, for the initial part of the phosgenation reaction; it may be increased to about 10-13 during the latter part of said reaction.

Following completion of both reactions, the block copolyestercarbonate may be isolated by conventional procedures. These may include, for example, anti-solvent precipitation, drying and pelletization via extrusion. It is also contemplated to conduct the first step by other ester-forming methods, as illustrated by transesterification using aromatic diesters and a 1,3-dihydroxybenzene either in a solvent or in the melt.

The block copolyestercarbonates of this invention are polymers having excellent physical properties. Their light transmitting properties are similar to those of polycarbonates. Thus, they are substantially transparent and may be employed as substitutes for polycarbonates in the fabrication of transparent sheet material when improved weatherability is mandated.

It is believed that the weatherability and other beneficial properties of the block copolyestercarbonates of the invention is attributable, at least in part, to the occurrence of a thermally or photochemically induced Fries rearrangement of the arylate blocks therein, to yield benzophenone moieties which serve as light stabilizers. For example, the moieties of formula I can rearrange to yield moieties of the formula

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wherein  $R^1$ ,  $R^2$ ,  $m$  and  $n$  are as previously defined. It is also contemplated to introduce moieties of formula III via synthesis and polymerization.

- 5                   The block copolyester carbonates may also be employed as weatherability-improving additives for other polymers, especially polycarbonates, polyesters and addition polymers. The polycarbonates in the blend compositions of the invention are, for the most part, similar in molecular structure to the carbonate blocks of the block
- 10 copolyester carbonate as described hereinabove, with bisphenol A homo- and copolycarbonates generally being preferred. The polyesters are most often poly(alkylene dicarboxylates) and especially poly(alkylene arenedioates), with poly(ethylene terephthalate) and poly(1,4-butyleneterephthalate) being preferred. Addition polymers
- 15 include homopolymers and copolymers, especially copolymers of alkenylaromatic compounds, such as styrene, with ethylenically unsaturated nitriles, such as acrylonitrile and methacrylonitrile; dienes, such as butadiene and isoprene; and acrylic monomers, such as ethyl acrylate. These include the ABS (acrylonitrile-butadiene-styrene) and
- 20 ASA (acrylonitrile-styrene-alkyl acrylate) graft copolymers.

The blend compositions of the invention may be prepared by such conventional operations as solvent blending and melt blending as by extrusion. They may additionally contain art-recognized additives including pigments, dyes, impact modifiers,

25 stabilizers, flow aids and mold release agents. It is intended that the blend compositions include simple physical blends and any reaction products thereof, as illustrated by polyester-polycarbonate transesterification products.

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Proportions of the block copolyestercarbonates in such blends are determined chiefly by the resulting proportions of arylate blocks, which are the active weatherability-improving entities, typical proportions providing about 10-50% by weight of arylate blocks in the blend. By reason of some degree of incompatibility between the block copolyestercarbonates of the invention and the polycarbonates and polyesters in which they may be incorporated, said blends are often not transparent. However, transparent blends may be prepared by adjusting the length of the arylate blocks in the block copolyestercarbonates. The other properties of said blends are excellent.

The block copolyestercarbonates of the invention, and blends thereof, may be used in various applications, especially those involving outdoor use and storage and hence requiring resistance to weathering. These include automotive body panels and trim; outdoor vehicles and devices such as lawn mowers, garden tractors and outdoor tools; lighting appliances; and enclosures for electrical and telecommunications systems.

The invention is illustrated by the following examples. All percentages and ratios are by weight unless otherwise indicated. Molecular weights were determined in chloroform by gel permeation chromatography relative to polystyrene and are reported as weight average ( $M_w$ ) or number average ( $M_n$ ).

#### EXAMPLES 1-10

A number of 1-l 4-necked flasks fitted with mechanical stirrers, nitrogen inlets, reflux condensers and two pressure-equalized addition funnels were charged with 5 mmol of tetra-n-butylammonium bromide (TBAB) or methyltri-n-butylammonium chloride (MTBAC), various amounts of resorcinol and 150 ml of degassed methylene chloride. The flasks were then purged with nitrogen and the addition funnels were charged with 212 mmol of 15% aqueous sodium hydroxide solution, maintained at 20°C and purged with nitrogen, and various degassed mixtures of isophthaloyl chloride and terephthaloyl chloride dissolved in 100 ml of methylene chloride.

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5 The sodium hydroxide solutions were added to the flasks under nitrogen, with stirring, whereupon the resorcinol dissolved to form translucent 2-phase mixtures. The isophthaloyl/terephthaloyl chloride mixtures were then added, with continued stirring, whereupon exotherms caused weak reflux. Stirring was continued for one hour at 35°C. The mixtures were then acidified with phosphorous acid to a pH of 3, the two phases were separated and the molecular weights of the resulting polyester intermediates were determined.

10 The polyester intermediate solutions were charged to phosgenation reactors fitted with stirrers, reflux condensers, phosgene inlets and pH-controlled sodium hydroxide delivery systems. There were added various proportions of bisphenol A, 2 mole percent (based on bisphenol A) of p-cumylphenol and, for each 100 mmol of bisphenol A, 0.1 ml of triethylamine and 0.5 ml of water. Phosgene, 120 mmol  
15 per 100 mmol of bisphenol A, was passed into the mixtures over 22 minutes, with pH control by addition of 30% aqueous sodium hydroxide solution, in the range of 8-9 until the final 5 minutes whereupon the pH was raised to 10.5-11.

20 The mixtures were acidified with dilute hydrochloric acid solution and the organic phases were separated and washed with water. The desired block copolyestercarbonates were precipitated by pouring into methanol and dried overnight at 60°C.

The results of the various examples are given in Table I. Examples 6-9 represent larger scale reactions (2.2 kg per batch).

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TABLE I

Ex.	Catalyst	Molar ratio, isophthaloyl/ terephthaloyl	Polyester intermediate, $M_w$	Polyester intermediate' $M_n$	Resorcinol, mole % excess	Product, % polyester blocks	Product $M_w$
1	TBAB	50/50	19,200	9,500	5	35	73,000
2	TBAB	50/50	16,900	8,300	5	35	95,000
3	MTBAC	50/50	17,000	8,600	5	50	99,000
4	TBAB	50/50	12,500	6,200	10	50	75,200
5	TBAB	70/30	32,300	16,100	3	50	86,500
6	MTBAC	50/50	17,200	8,900	5	50	90,700
7	MTBAC	50/50	32,400	16,500	3	50	81,200
8	MTBAC	50/50	14,500	7,200	5	80	78,100
9	MTBAC	50/50	24,300	12,100	5	20	75,100
10	MTBAC	50/50	53,500	28,100	3	20	67,300

## EXAMPLE 11

Samples (2 g) of the product of Example 6 and several other materials, described hereinafter, were dissolved in methylene chloride or chloroform (8 ml) and films with a thickness of about 250  
5 microns were drawn on glass plates with a doctor blade. The solvents were evaporated, leaving films approximately 40 microns thick which were floated from the glass plates with water. The haze values of the films were determined using a Gardner XL-835 haze meter.

The results are given in Table II. The following other  
10 materials were evaluated: a commercial bisphenol A polycarbonate (PC), a resorcinol polyarylate having a ratio of isophthalate to terephthalate groups of 1:1 and a molecular weight of about 50,000 (RPA), a blend of PC with the product of Example 6 and two PC-RPA blends.

15

TABLE II

Film material	Haze, %
Example 6	0.8
PC	0.8
RPA	0.8
PC/Ex. 6, 1.5:1	12.7
PC/RPA, 4:1	69.0
PC/RPA, 1:1	38.5

These results show the improved compatibility of blends of the block copolyestercarbonate of Example 6 with polycarbonate, as compared with polyarylates not containing carbonate blocks.

## EXAMPLES 12-16

20

To 1-l 3-necked flasks equipped with reflux condensers, mechanical stirrers and pressure equilibration addition funnels were added various amounts of resorcinol and triethylamine and 100 ml of methylene chloride. The flasks were blanketed with nitrogen and solutions of 10.151 g (50 mmol) each of isophthaloyl chloride and

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terephthaloyl chloride in 150 ml of methylene chloride were added dropwise over 4-8 minutes, so as to maintain a gentle reflux. The mixtures were further stirred at reflux temperature for 30 minutes, then transferred to separation funnels and washed once with water, twice  
5 with dilute aqueous hydrochloric acid and again with water.

The oligomer solutions were transferred to phosgenation reactors similar to those of Examples 1-10. After addition of bisphenol A, triethylamine (1 mole percent based on bisphenol A), water and p-cumylphenol as a chain termination agent, the phosgenation was  
10 conducted as described in said examples.

The results and product parameters are given in Table III. All of the copolymers contained 50% polyarylate units.

TABLE III

Ex.	Resorcinol, g	Triethylamine, ml	Bisphenol A, g	CH <sub>2</sub> Cl <sub>2</sub> for phosgenation, ml	Water for phosgenation, ml	Polyester intermediate, Mw	Polyester intermediate, Mn	Product Mw
12	13.76	36	22	250	50	10,500	3,500	77,200
13	12.23	32	21.7	250	50	20,000	6,300	85,500
14	11.59	32	21.5	250	50	28,500	10,700	86,300
15	11.236	31	21.2	250	50	43,700	13,500	90,500
16	22.02	58	31	300	55	3,550	1,440	32,700



## EXAMPLE 17

Various block copolyestercarbonates of Examples 12-16 were solution blended with a commercially available bisphenol A polycarbonate, and films were cast from these solutions using the procedure of Example 11. Haze measurements were made and are given in Table IV.

TABLE IV

Copolymer ex.	Copolymer, g	PC, g	Haze, %
12	0.4	1.6	4.32
12	0.8	1.2	5.54
12	1.0	1.0	22.6
12	1.5	0.5	14.6
12	2.0	0.0	0.33
13	2.0	0.0	0.27
14	2.0	0.0	0.29
15	2.0	0.0	0.22
16	0.4	1.6	0.58
16	0.8	1.2	1.09
16	1.0	1.0	1.27
16	1.5	0.5	2.75
16	2.0	0.0	0.39

It is apparent that the neat copolymers, as well as some of the blends using the copolyestercarbonate of Example 16, gave essentially transparent, haze-free films.

## EXAMPLE 18

Blends of PC with various proportions of RPA or of the product of Example 6 and with various colorants (titanium dioxide at 2%, carbon black at 0.6%, black dye at 0.47%) were prepared by dry blending followed by extrusion and were injection molded into test samples. The samples were subjected to accelerated weathering tests in an Atlas Ci35a xenon arc weatherometer equipped with borosilicate inner and outer filters at an irradiance of 0.77 W/m<sup>2</sup> at 340 nm, using cycles of 160 min light, 5 min dark and 15 min dark with water spray. The proportions of gloss retention (60° angle) after a total exposure of 935 kJ/m<sup>2</sup> are listed in Table V.

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TABLE V

Polymers	Colorant	Gloss retention, %
PC	Titanium dioxide	17
PC/RPA 10%	Titanium dioxide	14
PC/RPA 20%	Titanium dioxide	30
PC/Ex. 6 10%	Titanium dioxide	36
PC/Ex. 6 20%	Titanium dioxide	37
PC	Carbon black	11
PC/RPA 10%	Carbon black	22
PC/RPA 20%	Carbon black	58
PC/Ex. 6 10%	Carbon black	40
PC/Ex. 6 20%	Carbon black	69
PC	Black dye	70
PC/RPA 10%	Black dye	55
PC/RPA 20%	Black dye	77
PC/Ex. 6 10%	Black dye	70
PC/Ex. 6 20%	Black dye	87

These results show the improvement in weatherability afforded by the block copolyestercarbonates of the invention in comparison with a simple polyarylate and with neat polycarbonate.

#### 5 EXAMPLE 19

Blends of PC, 30% of a commercially available poly(1,4-butylene terephthalate) (PBT) and 0.47% of the black dyes of Example 18 were dry blended, extruded and injection molded into test specimens which were evaluated in the apparatus of Example 18, alone and in combination with RPA and the product of Example 6. The light exposure required, in kJ/m<sup>2</sup> of energy at 340 nm, to cause 50% loss of gloss was determined for each specimen and the results are given in Table VI.

TABLE VI

PC, %			Exposure,
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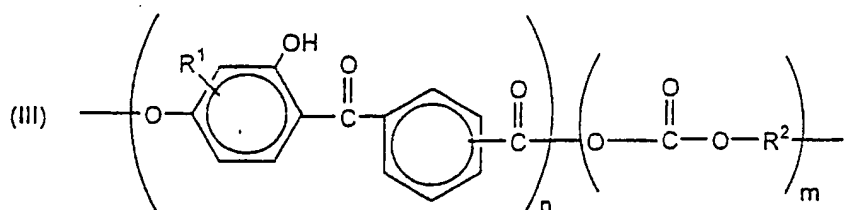
- 17 -

	RPA, %	Ex. 6, %	kJ/m <sup>2</sup>
70	--	--	420
50	20	--	864
30	--	40	1,400

It is again apparent that the presence of the block copolyestercarbonate of the invention improves the weatherability of the blend to a significant extent.

What is claimed is:

1. A block copolyestercarbonate comprising organic carbonate blocks alternating with arylate blocks, said arylate blocks comprising arylate structural units derived from a 1,3-dihydroxybenzene and at least one aromatic dicarboxylic acid and  
5 having a degree of polymerization of at least about 4.
2. A block copolyestercarbonate according to claim 1 wherein the carbonate blocks consist of bisphenol A carbonate units.
3. A block copolyestercarbonate according to claim 1 wherein the degree of polymerization of the carbonate blocks is at least about 10.
4. A block copolyestercarbonate according to claim 1 wherein the arylate blocks are resorcinol isophthalate or resorcinol terephthalate blocks or a mixture thereof.
5. A block copolyestercarbonate according to claim 4 wherein the arylate blocks are derived from a mixture of isophthalic and terephthalic acids.
6. A block copolyestercarbonate according to claim 5 wherein the molar ratio of isophthalate to terephthalate in the arylate blocks is in the range of about 0.25-4.0:1.
7. A block copolyestercarbonate according to claim 5 wherein the degree of polymerization of the arylate blocks is at least about 10.
8. A block copolyestercarbonate according to claim 5 which consists of about 10-90% by weight arylate blocks.
9. A block copolyestercarbonate comprising moieties of  
the formula

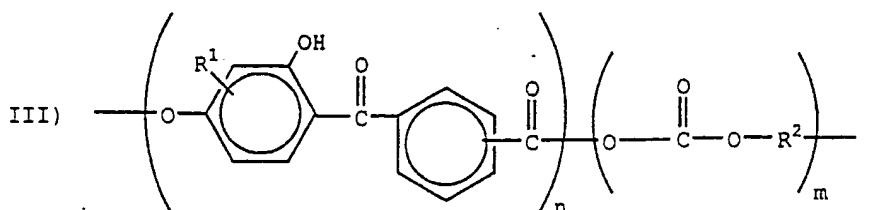


wherein  $R^1$  is hydrogen, halogen or  $C_{1-4}$  alkyl, each  $R^2$  is independently  
 5 a divalent organic radical,  $m$  is at least about 10 and  $n$  is at least about 4.

10. A block copolyester carbonate according to claim 9 wherein  $R^1$  is hydrogen,  $R^2$  is *p*-phenyleneisopropylidene,  $n$  is at least about 10 and  $m$  is at least about 20, said copolyester carbonate consisting of isophthalate and terephthalate ester blocks in a molar  
 5 ratio in the range of about 0.8-2.5:1.

11. A block copolymer obtained by Fries rearrangement of a block copolyester carbonate according to claim 1.

12. A block copolymer according to claim 11 comprising moieties of the formula



wherein  $R^1$  is hydrogen, halogen or  $C_{1-4}$  alkyl, each  $R^2$  is independently  
 5 a divalent organic radical,  $m$  is at least about 10 and  $n$  is at least about 5.

13. A block copolymer according to claim 12 wherein  $R^1$  is hydrogen,  $R^2$  is *p*-phenyleneisopropylidene,  $n$  is at least about 10 and  $m$  is at least about 20, said copolyester carbonate consisting of isophthalate and terephthalate ester blocks in a molar ratio in the  
 5 range of about 0.8-2.5:1.

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14. A composition comprising a resinous blend of a block  
copolyestercarbonate according to claim 1 with at least one other  
polymer selected from the group consisting of polycarbonates,  
poly(alkylene dicarboxylates) and addition polymers, and any reaction  
5 products thereof.

15. A blend according to claim 14 wherein the other  
polymer is a polycarbonate.

16. A blend according to claim 15 wherein the other  
polymer is a bisphenol A polycarbonate.

17. A blend according to claim 14 wherein the other  
polymer is a poly(alkylene dicarboxylate).

18. A blend according to claim 17 wherein the other  
polymer is poly(1,4-butylene terephthalate).

19. A blend according to claim 17 wherein the other  
polymer is poly(ethylene terephthalate).

20. An article made from the composition of claim 14.

21. An article according to claim 20 comprising an  
enclosure for an electrical and telecommunications system.

22. A method for preparing a block copolyestercarbonate  
5 which comprises:

(A) preparing a hydroxy-terminated polyester  
intermediate having a degree of polymerization of at least 4 by the  
reaction of a 1,3-dihydroxybenzene with at least one aromatic  
dicarboxylic acid chloride under alkaline conditions, and

10 (B) conducting a reaction of said polyester intermediate  
with at least one organic dihydroxy compound and a carbonyl halide.

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23. A method according to claim 20 wherein the molar ratio of resorcinol or alkylresorcinol to acyl chlorides in step A is in the range of about 1.01-1.90:1.

24. A method according to claim 20 wherein the 1,3-dihydroxybenzene in step A is resorcinol and the dicarboxylic acid chloride is isophthaloyl chloride, terephthaloyl chloride or a mixture thereof.

25. A method according to claim 20 wherein the organic dihydroxy compound in step B is bisphenol A and the carbonyl halide is phosgene.

26. A method according to claim 20 wherein steps A and B are both conducted in a 2-phase system including an aqueous phase and a water-immiscible organic solvent.

27. A method according to claim 20 wherein the pH in step B is maintained in the range of about 5-9 for the initial part and increased to about 10-13 during the latter part of said reaction.

Int	national Application No
PCT/US 99/20413	

According to International Patent Classification (IPC) or to both national classification and IPC

**8. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 193 176 A (UNION CARBIDE)  3 September 1986 (1986-09-03)</p> <p>page 1, paragraph 2 -page 2, paragraph 2  page 6, paragraph 3  page 12, paragraph 2  page 18 -page 19  claims 1,9</p> <p style="text-align: center;">—  -/-</p>	<p>1,2,9,  11,12,  14,20,22</p>

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "A" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

**9 December 1999**

17/12/1999

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Authorized officer \_\_\_\_\_

Hoepfner, W



## INTERNATIONAL SEARCH REPORT

Int. Patent Application No.  
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	EP 0 448 814 A (BAYER) 2 October 1991 (1991-10-02) page 1, line 1 - line 22 page 5, line 33 - line 38 page 5, line 57 examples 5,6	1-8, 20-22

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